

6942

U-004-307 .18

---

PERMEABILITY OF GLACIAL TILL, BY STANLEY E. NORRIS,  
COLUMBUS, UNITED STATES GEOLOGICAL SURVEY RESEARCH  
ARTICLE 224 - (USED AS A REFERENCE IN OU2 RI REPORT)

00/00/62

2  
SURVEY

## GROUND WATER

## 224. PERMEABILITY OF GLACIAL TILL

By STANLEY E. NORRIS, Columbus, Ohio

*Work done in cooperation with the Division of Water of the Ohio Department of Natural Resources and with the Miami Conservancy District*

Glacial till controls in varying degree the availability of ground water in thousands of square miles in the northern United States. Where it mantles broad areas of upland, till retards the infiltration of precipitation to underlying aquifers. Also, in valleys where the water table is hydraulically continuous with a river, a layer of till within the zone of saturation may confine the aquifer below it and greatly limit recharge, by induced infiltration of streamflow, to the confined aquifer.

Despite its hydrologic importance, very few data on the permeability of till have been published. One reason for this lack of permeability determinations is that till is a poor aquifer. No doubt another reason is that many hydrogeologists believe that a permeability value, or even a range of such values, for till at one place would be meaningless if applied to till in other places. The latter idea may stem from a widespread misconception that till is a more or less random accumulation of drift, ranging widely in its physical properties from place to place and lacking continuity in many of the common lithofacies characteristics upon which correlation of sediments is based. On the contrary, evidence shows that till in widely separated areas actually is reasonably uniform in permeability and, by inference, in other related properties. Most values of the permeability coefficient of till in Ohio are similar to those for till in Illinois and South Dakota (fig. 224.1). This is true for determinations made both in the laboratory and by aquifer tests.

Laboratory determinations of permeability of till are reported for 10 samples from Spink and Hand Counties, east-central South Dakota; 3 from Montgomery County, southwest Ohio; and 13 from Holmes, Wayne, Medina, and Ashland Counties, northeast Ohio. Field computations of till permeability based on aquifer tests are reported for 5 sites in the Mad River valley, Montgomery County, Ohio, and for 7 sites in southern Illinois. The laboratory tests were made in the Hydrologic Laboratory of the Geological Survey.

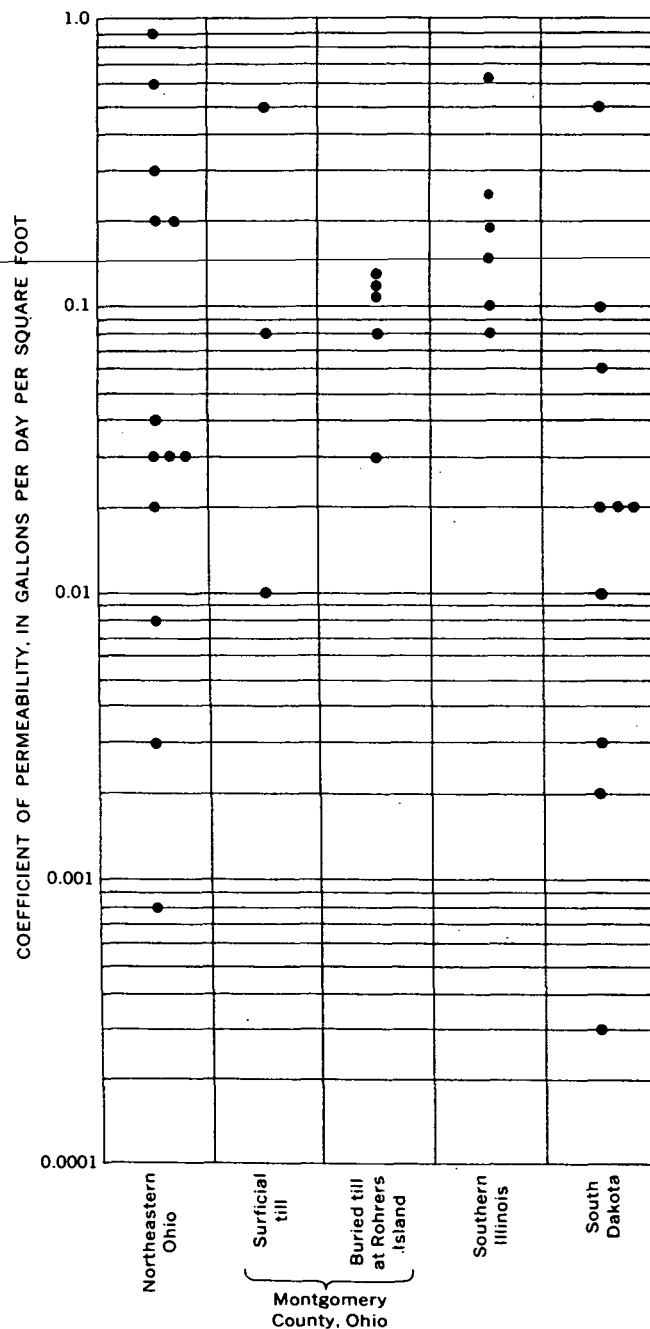


FIGURE 224.1.—Chart showing range of till permeability in Ohio, Illinois, and South Dakota.

The samples from South Dakota were obtained with a diamond core barrel and hydraulic drill, either from surface exposures or at depths ranging from about 18 to 110 feet. Presumably they represent till of Wisconsin age, as do also the Ohio samples.

Four samples of surficial till from Montgomery County, Ohio, were collected by driving thin-walled aluminum cylinders 6 inches in diameter and 6 inches in length into the till, thus cutting an "undisturbed" core. The hardest and most resistant till sampled had a coefficient of permeability of 65 gallons per day per square foot. Because this is an excessively high value, the sample is believed to have cracked before it reached the laboratory. Therefore, the value is not shown on figure 224.1.

Sixteen samples of surficial till were collected in northeastern Ohio also by driving cylinders into the till, but, as the cylinders were smaller—2 inches in diameter and about 2 inches in length—sampling was much easier and the resulting cores are believed to have been disturbed less than those collected in the larger cylinders. Nevertheless, 3 of the 16 samples had either shrunk or cracked en route to the laboratory and so were not tested for permeability.

The permeability of till of early Wisconsin age in the Mad River valley at Rohrer's Island, near Dayton, Montgomery County, Ohio, was determined by analysis of an aquifer test (Norris, 1959). The till ranges in thickness from about 11 to 50 feet and lies between 2 deposits of water-bearing sand and gravel, of which the upper averages about 65 feet in thickness and the lower about 50 feet. The permeability of the till was determined from its effect on water-level fluctuations in 5 observation wells whose distance from the pumped well ranged from 510 to about 4,200 feet.

Walton (1960) determined the permeability of till at seven sites in southern Illinois from aquifer tests. At 6 of the sites the till, which ranges in thickness from 7 to 16 feet, is presumed to be of Illinoian age; at the other site the till is 12 feet thick and is of Wisconsin age. The permeability of the till at one site was computed to be 1.6 gallons per day per square foot. As this value is nearly three times as great as the maximum value for the till at the other sites, it is thought not to be representative and so is not shown on figure 224.1.

The permeability values determined by analysis of the aquifer test at Rohrer's Island compare closely with those determined in the laboratory for surficial tills from elsewhere in Montgomery County, Ohio. Moreover, the permeability values for till in Illinois are in the same range as those for till in Montgomery County, and although the range of permeability values of the samples collected in northeast Ohio and in South Dakota is relatively large, most values are in the same range as that of the till in southwest Ohio and in Illinois.

The close grouping of most of the permeability values suggests that, with judgment, they can be extrapolated over large distances and applied with reasonable confidence in estimating the rate of percolation through glacial till to underlying aquifers.

#### REFERENCES

- Norris, S. E., 1959, Vertical leakage through till as a source of recharge to a buried-valley aquifer at Dayton, Ohio: Ohio Dept. Nat. Resources, Div. of Water Tech. Rept. 2.
- Walton, W. C., 1960, Leaky artesian aquifer conditions in Illinois: Illinois State Water Survey, Dept. Registration and Education Rept. Inv. 39.

✕